Patents

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	
Jeffrey H. Mumm & Hugh C. Gardner	Art Unit: **1733**
Serial No. **09/696,519**	Examiner: **John Goff II**
Filed: **October 25, 2000**	Confirmation No.: **2591**
For: **Carpets with Improved Fuzz Resistance**	

DECLARATION PURSUANT TO 37 C.F.R. § 1.132

Commissioner for Patents
Washington, DC 20231

Sir:

I, Hugh C. Gardner, residing at 2754 Long Lake Drive, Roswell, Georgia, and being duly warned, hereby declare and say:

1. I am submitting this declaration in response to the telephone interview with Examiner Goff on May 24, 2005 and to establish the following:

(A) the claimed thermoplastic binder of the invention consists entirely or essentially of a thermoplastic polyethylene resin having flow properties corresponding to an MI of about 2.2 to about 105 g/10 min as measured in accordance with ASTM D 1238; and a viscosity between approximately 230,000 and 4,881,000 cps at about 270°F with a shear rate of about 10 sec^{-1} as measured in accordance with ASTM D 3835, and as set forth in each independent claim of this patent application;

(B) the aforementioned claimed parameters for the inventive thermoplastic binder are not taught by the prior art, especially by U.S. Patent No. 3,684,600 issued in the name of Smedberg (hereinafter, the "Smedberg '600 reference"); and

(C) the aforementioned claimed parameters for the inventive thermoplastic binder in combination with the other elements of each of the independent claims yield unexpected results to those of ordinary skill in the art.

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Background on Declarant/Inventor:

2. I was awarded a Bachelor of Science degree in Chemistry from Rensselaer Polytechnic Institute in 1968, a Master of Science degree in Chemistry from Indiana University in 1970, and a Ph.D. degree in Chemistry from Indiana University in 1975.

3. Since 1991, I have been employed by Amoco Fabrics and Fibers Company ("Amoco") of Austell, Georgia. Amoco has now sold this business to Propex Fabrics, Inc. of Georgia ("Propex"). Propex makes and sells synthetic fibers and fabrics that are used as primary and secondary backings for carpets, and in construction and packaging applications. I am currently Manager of Product Development and have held that position since 2001, when the business was owned by Amoco.

4. My responsibilities include supervising engineers, scientists, and process specialists who develop new products and provide technical support for all of Propex's product lines. From 1991 until my current position, I held positions as Research Associate and Manager of Technical Services, with direct and supervisory responsibilities related to new product development and technical support for both Amoco's and Propex's product lines. Before being employed by Amoco, I was employed by Amoco Performance Products, Inc., of Alpharetta, Georgia, as Director of Advanced Composites Research and Development. In that position my responsibilities included supervising scientists and engineers who developed thermoplastic and thermoset composites for aircraft, aerospace, sporting goods, and ordnance applications.

5. I am a current member of several technical committees of the Carpet and Rug Institute, which is a leading trade association for the United States carpet industry, and of the Research Advisory Committee of the Georgia Textile Manufacturer's Association. I am, and for approximately thirty-five years have been, a member of the American Chemical Society.

6. I am a sole or joint inventor of about forty United States Patents in the fields of advanced thermoset composites and prepregs, their components and applications, and synthetic fabrics for carpet backing and industrial applications.

7. I consider myself to be one of ordinary skill in technical fields related to synthetic carpet backings, carpets with synthetic backings, and their manufacture. I am making this declaration as one of ordinary skill in the art for those fields.

8. I am a co-inventor of United States Patent Application No. 09/696,519 (the "Application"). I have read a copy of an Office Action of the United States Patent and Trademark Office mailed May 27, 2004 (the "Office Action"), and understand all claims of the Application have been rejected. I understand that the Smedberg '600 reference is a basis for rejecting the claims pending in this patent application.

How Melt Index (MI) data for the Thermoplastic Resins in the Patent Application relate to Viscosity Data for the hot melt adhesive backcoat compositions in the Smedberg '600 reference:

Science and Equations:

9. A fundamental relationship in the flow of fluids is

$$\text{(apparent viscosity)} = \frac{\text{(shear stress)}}{\text{(shear rate)}} \qquad (1)$$

10. The fluids governed by these equations can be watery liquids or stiff, rubbery melts. In the plastics industry, which typically deals with stiff molten materials, the term "apparent viscosity" is often referred to as "viscosity."

11. In the above equation, viscosity is the resistance of a fluid or molten material to a change in form (i.e., flow). Shear rate measures the amount of material that has moved as a result of an applied force. Shear stress is a measure of the amount of applied force. A key point is that for a fixed shear stress, an increase in viscosity must be accompanied by a decrease in shear rate.

12. In the plastics industry, several instruments are used to measure the flow properties of polymers. Examples of such instruments include the extrusion plastometer made by Tinius Olsen (Horsham, PA), the high shear rate capillary rheometer made by Kayeness, Inc., a

division of Dynisco, Inc. (Franklin, MA), and a Model RVT rotary viscometer made by Brookfield Engineering Laboratories (Middleboro, MA). The choice of test instrument depends on the stiffness (i.e., viscosity) of the material and type of information required. Data from all three test instruments is interrelated.

13. The Tinius Olsen extrusion plastometer and the Kayeness rheometer are capillary rheometers. They generate flow information by forcing molten polymer through a small die and measuring the amount of material that passes through during a fixed interval.

14. Two common procedures for measuring the flow properties of polymers are ASTM D 1238, Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer, and ASTM D 3835, Determination of Properties of Polymeric Materials by Means of a Capillary Rheometer.

15. ASTM D 1238 is carried out using a specific die orifice size (2.096 mm), die length (8.00 mm), and cylinder diameter (9.55 mm). The test method states that a common test condition for polyethylene resins is 190°C and a weight of 2.16 kg.

16. Note 27 in ASTM D 1238 states "it is customary to refer to the flow rate of polyethylene as "melt index" under condition 190/2.16." The melt index (MI) is defined as the grams of polymer extruded over a 10-minute period.

17. ASTM D 1238 Condition 190/2.16 is carried out under a constant shear stress. At a fixed temperature, low MI resins are more difficult to deform (i.e., cause to flow) than high MI resins. Consequently, because of the relationship in equation 1 above, the viscosity of a low MI resin will be higher than the viscosity of a high MI resin.

__MIs for the Polyethylene Resins of the Claimed Invention:__

18. Exemplary embodiments of the polyethylene resins in the instant invention have MI's of 105 g/10 min, 27 g/10 min, and 3 g/10 min. Specifically, as set forth in the originally filed description, MI 27 resin is embodied in Examples 1 through 40. MI 105 resin is embodied in combination with the MI

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27 resin in Examples 2, 17, 18, and 37 as set forth in the originally filed description. The MI 3 resin is embodied in Example 41 of the originally filed description.

<u>Relationship Between MI, Shear Rate, and Viscosity:</u>

19. When applied to polyethylene, ASTM D 1238 Condition 190/2.16 establishes the following relationship between the MI of the resin and the shear rate for the measurement:

$$\text{shear rate} = 2.38 \times \text{MI} \qquad (2)$$

20. The units of shear rate are sec^{-1}, and the units of MI are grams per ten minutes. At 190°C, the melt density of polyethylene is 0.7637 g/cm^3. Equation 2 holds for the specific condition mentioned above. The general form of the equation applies at other temperatures and under other extrusion conditions. The primary difference is that the factor (i.e., 2.38) changes as a function of the test conditions.

21. Since the shear stress for ASTM D 1238 Condition 190/2.16 is a constant determined by the setup (weight, plunger size, orifice size, and orifice length), and the shear rate can be calculated by equation 2 using the melt index, the viscosity of the material can be calculated by substituting the values for shear stress and shear rate into equation 1.

22. The result is a viscosity in the units of Pascal-seconds. The result can be converted to centipoises by multiplying it by 1000.

23. ASTM D1238 is used primarily as a quality control test. MI is a one point indication of the flow properties of the resin. MI data gives plastics processors information about which grades of polyethylene are most suitable for their equipment.

24. As discussed above, the shear stress is fixed in ASTM D 1238. Consequently, both the shear rate (and MI) and viscosity must change in opposite directions for equation 1 to be valid. This makes it difficult to compare resins under conditions of constant shear rate using ASTM D 1238 data.

25. A more versatile test of resin flow properties is ASTM D 3835. This procedure allows shear rates and shear stress to be measured independently. The test result is often displayed as a log-log plot of viscosity versus shear rate. These figures are called flow curves. Examples of such data are discussed in subsequent paragraphs 31-33 below.

26. A high shear rate capillary rheometer such as the Kayeness rheometer has the ability to measure the flow properties of resins over a wide range of shear rates and shear stresses using ASTM D 3835. This unit forces heat-softened plastic material through a specified die using a ram at a known ram speed and material temperature. The force needed to maintain the constant ram speed is measured and recorded. The shear rate is calculated by a formula that includes the rate of travel of the piston and the orifice diameter. The shear stress is calculated by measuring the pressure on the ram required to maintain the speed and incorporating it into a formula that also includes the orifice diameter and orifice length. Because both shear stress and shear rate are known, the viscosity can be determined according to equation 1. As shown below, log-log plots of viscosity versus shear rate can be generated. At a given temperature, each resin has a characteristic flow curve.

27. By comparing flow curves for different resins at a specified shear rate and fixed temperature, it is possible to assess differences in viscosity between resins.

28. To compare resins whose properties have been measured using different techniques (e.g., one resin measured by capillary rheometry and another measured by Brookfield rotary viscometry), viscosity data can be compared at the same temperature and a fixed shear rate.

Why Temperature of 270 Degrees Fahrenheit was Selected for Comparison to Prior Art:

29. In my previous Declaration submitted on November 24, 2004, viscosity data for the MI 27 and MI 105 resins at temperatures between 250°F and 310°F was presented. This data was provided because that temperature range was common to the Smedberg '600 reference and our teachings. Our objective was to show how the viscosities of the resins in the present applications differed substantially from the viscosities in the hot melt adhesive backcoats in the Smedberg '600 reference. The data generated at a shear rate of 97 sec^{-1} was included in Paragraph 16 of my previous declaration.

Data for Viscosity and Shear Rates for Embodiments of the Claimed Invention:

30. The following data in paragraphs 31-33 was generated according to ASTM D 3835 at Plastics Technology Laboratories, Inc., a certified polymer testing laboratory in Pittsfield, MA.

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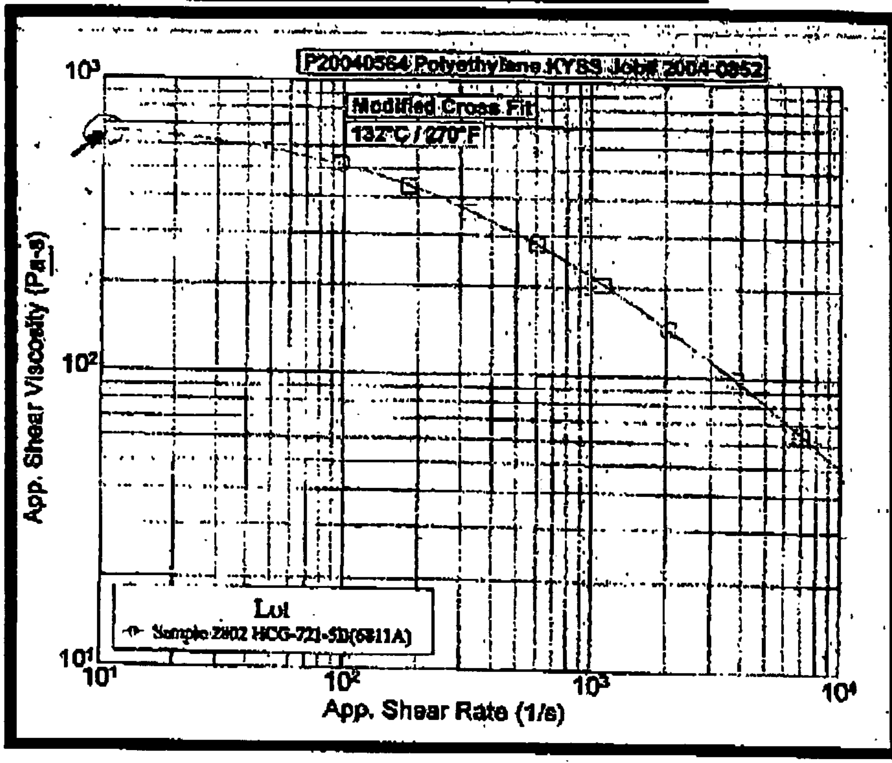
Viscosity and Shear Rates for Exemplary Embodiments of the Invention with MI = 27:

31. The Graph to the right shows the flow curve for the MI 27 polyethylene resin at 132°C (270°F). Data points were collected at shear rates ranging from 97 sec^{-1} to 7005 sec^{-1}, and a smooth curve was generated for the shear rate range of 10 sec^{-1} to 10,000 sec^{-1}. The viscosity at 97 sec^{-1} (i.e., 521.5 Pascal-sec, or 521,500 centipoises) was reported in the previous declaration. The estimated viscosity at a shear rate of 10 sec^{-1} is 650,000 centipoises based on extrapolation of the curve in the Figure above. See also the data points for the curve listed below:



Capillary Rheometry Results

Date: 12-Mar-04 11:10
Operator: AJC
Material: PE
Supplier: Amoco Fabrics and Fibers
Customer: Robert Wiebe
Device: LC 9 kN, 2000 lb
Comments: P20040564 Shear sweep @ 132°C

Sample ID: KYSS Job: 2004-0852
Workorder: 1603
Lot#: Sample 2802 HCG-721-
Die: 2304-30 6811A
Delay Time: 0 s

Temperature: 132 C
Packing Force: 2043 N
Start Position: 110 mm
Melt Time: 360 s
Die Diameter: [illegible] mm
Die Length: [illegible] mm
HCAL: 6109 N
PTS: 9

Point	Force (N)	Pos (mm)	Ram (mm/min)	Time (min)	Stress (Pa)	Rate (1/s)	Visc. (Pa-s)	X-D (mm)
1	3871.3	136.6	576	6	450339	7004.9	64.3	
2	3234.9	157.2	313	6.1	376312	3806.5	98.9	
3	2593.4	168.7	170	6.2	301691	2067.4	145.9	
4	1964.2	177.6	92	6.3	228406	1118.8	204.2	
5	1472.9	184.9	50	6.4	171343	608.1	281.8	
6	1015.3	192	27	6.7	118110	328.4	359.7	
7	684.4	196.8	15	7	79611	182.4	436.4	
8	436.2	200.1	8	7.4	[illegible]	97.3	521.5	
9	1469.9	209.7	50	7.6	[illegible]	608.1	281.2	
Average:	1860.3	188.4	144.6	6.6	216403	1758.0	266.0	
Max:	3871.3	209.7	576.0	7.6	450339	7004.9	521.5	
Min:	436.2	136.6	8.0	6.0	50737	97.3	64.3	

512.5 Pa-S
5,125 poise
512,500 centipoise

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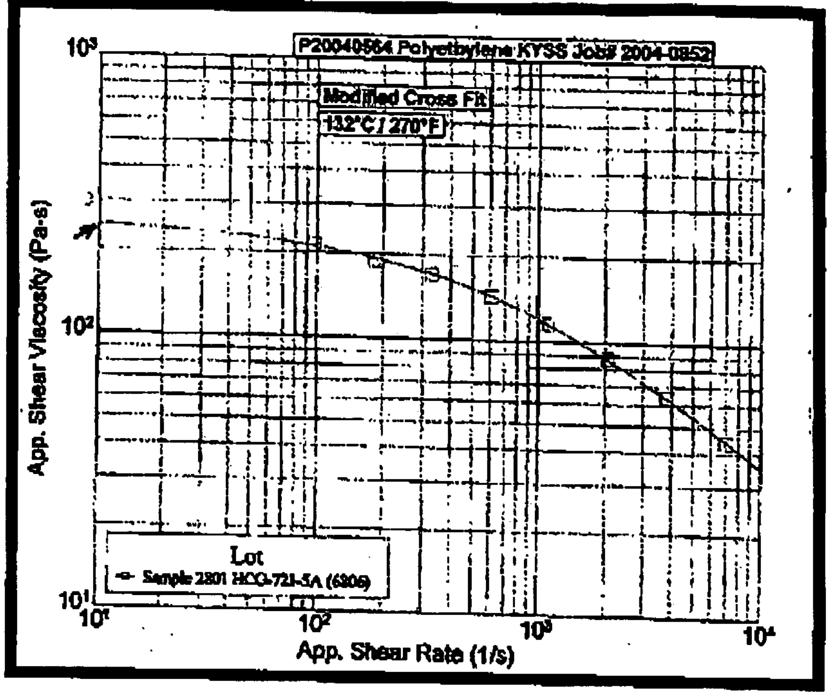
Viscosity and Shear Rates for Exemplary Embodiments of the Invention with MI = 105:

32. The Graph to the right shows the flow curve for the MI 105 polyethylene resin at 132°C (270°F). Data points were collected at shear rates ranging from 97 sec^{-1} to 7005 sec^{-1}, and a smooth curve was generated for the shear rate range of 10 sec^{-1} to 10,000 sec^{-1}. The viscosity at 97 sec^{-1} (i. e., 215 Pascal-sec, or 215,000 centipoises) was reported in the previous declaration. The estimated viscosity at a shear rate of 10 sec^{-1} is 230,000 centipoises based on extrapolation of the curve. See the data points for the curve listed below:



Capillary Rheometry Results

WinKarr 1.90

Date: 11-Mar-04 15:20
Operator: AJC
Material: PE
Supplier: Amoco Fabrics and Fibers
Customer: Robert Wiebe
Device: LC 9 kN, 2000 lb
Comments: P20040564 Shear sweep @ 132°C

Sample ID: KYSS Job: 2004-0852
Workorder: 1601
Lot#: Sample 2801 HCG-721- 6806
Die: 2394-30
Delay Time: 0 s

Temperature: 132 C ← 270°F
Packing Force: 2043 N
Start Position: 110 mm
Melt Time: 360 s
Die Diameter: 1.000 mm
Die Length: 30.000 mm
RCAL: 6108 N
PTS: 9

Point	Force (N)	Pos (mm)	Ram (mm/min)	Time (min)	Stress (Pa)	Rate (1/s)	Visc. (Pa-s)	X-D (mm)
1	2648	136.3	576	6	308039	7004.9	44	
2	2088.2	151.5	333	6.1	242914	3806.5	63.8	
3	1563.1	161.2	170	6.2	181829	2067.4	87.9	
4	1110.5	170	92	6.3	129182	1118.8	115.5	
5	746.8	194.6	50	6.7	86874	608.1	142.9	
6	480.2	202	27	7	55856	328.4	170.1	
7	300.4	204	15	7.2	34940	182.4	191.5	
8	(179.8)	206.1	8	7.4	20916	97.3	215 ←	
9	742.7	220.1	50	7.7	86398	608.1	142.1	
Average:	1095.5	182.9	144.6	6.7	127439	1758.0	130.3	
Max:	2648.0	220.1	576.0	7.7	308039	7004.9	215.0	
Min:	179.8	136.3	8.0	6.0	20916	97.3	44.0	

215 Pa-S
2150 poise
215,000 centipoises

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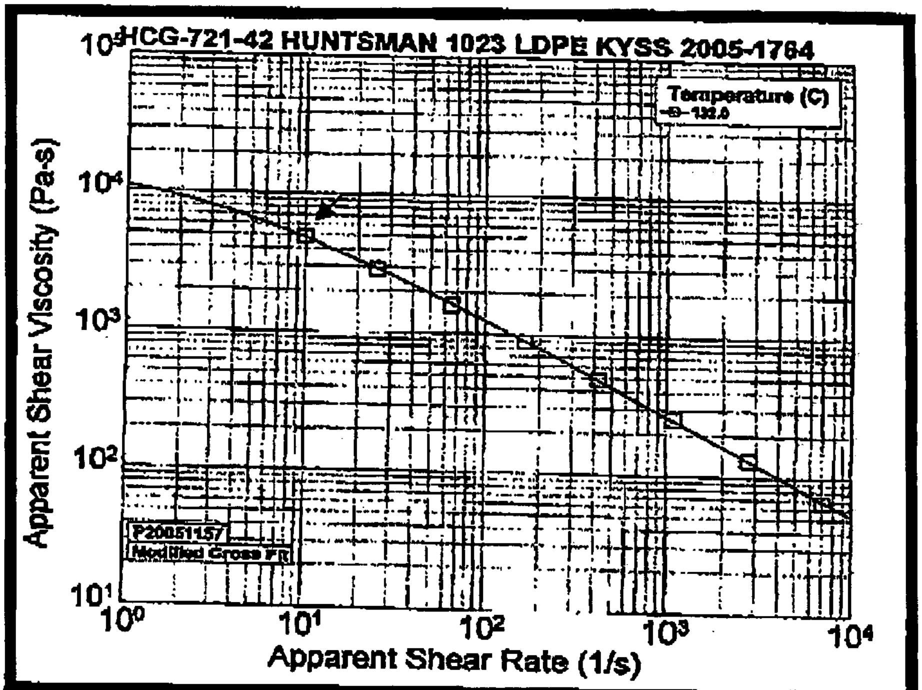
<u>Viscosity and Shear Rates for Exemplary Embodiments of the Invention with MI = 2.2:</u>

33. The Graph to the right shows the flow curve for a MI 2.2 polyethylene resin at 132°C (270°F). This resin was recently tested because the MI 3 resin in Example 41 of the patent application is no longer available. This resin (type 1023 from Huntsman Polymers) has the same density as the resin described in Example 41. This MI of 2.2 is within the range specified in the instant patent application (MI 1 to MI 200).



See Application page 57, lines 8-11. Data points were collected at shear rates ranging from 9.97 sec^{-1} to 7016 sec^{-1}. The viscosity at 9.97 sec^{-1} (i.e., 4,881 Pascal-sec, or 4,881,000 centipoises) was recently measured and was not reported in the previous declaration. See the data points of the curve listed below:

Capillary Rheometry Results

Date: 6/21/2005 11:25:21 AM
Operator: AJC
Die: CZ394-30
Sensor 1: LC-103N

Workorder: 586
Sample ID: HCG-721-42
Temperature: [illegible]
Lot #: P20051157
Points: 9

Start Position: 100 mm
Melt Time: 360 s
RCAL 1: 99.99 %

Machine #, Serial #: 7001, 4009

Point #	Sensor1 Force (N)	Position (mm)	RamRate (mm/min)	Time (min)	Shear Stress 1 (kPa)	Shear Rate 1 (1/s)	Shear Viscosity1 (Pa-s)
1	4034	127.2	578.9	6.05	469.32	7015.97	65.89
2	3134	140.6	226.3	6.11	364.57	2761.99	132.47
3	2391	147.5	88.8	6.16	278.15	1079.44	257.68
4	1771	152.8	34.8	6.34	205.99	423.46	486.44
5	1274	158.8	13.7	6.78	148.21	166.12	892.18
6	906	161.6	5.4	7.28	105.39	65.19	1616.82
7	631	163	2.1	8.00	73.44	25.54	2875.48
8	418	164	0.8	9.21	[illegible]	[illegible]	[illegible]
9	1762	173.3	34.8	9.49	205.00	423.46	484.11

48,810 poise

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Problems with Identifying Physical Parameters of the Resins in the Smedberg '600 reference:

34. One of the challenges in comparing the thermoplastic resins in the instant invention with the hot melt adhesive backcoats in the Smedberg '600 reference is that Smedberg does not present sufficient information about how the viscosity data was obtained. There is no discussion of the apparatus or method of viscosity measurement. As indicated above, it is not possible to accurately compare resin flow data (i. e., viscosity data) without knowing the shear stress and shear rate at which the test was run.

35. To make a comparison with the Smedberg hot melt adhesive compositions, we have made assumptions about the viscosity measurement method based on our knowledge of a) the types of equipment used to measure viscosities of such compositions, b) the properties of hot melt backcoat compositions similar to those described in the '600 reference, and c) the data in related patents issued to the same Assignee.

How Viscosity was measured in the Smedberg '600 reference:

36. In the 1970's, hot melt adhesive compositions were characterized using a Brookfield Model RVT viscometer. An upgraded version of that instrument is available today from Brookfield Engineering. Patents that are disclosed in the Smedberg '600 reference, such as US patent application serial No. 789,605 (now US 3,583,936), taught that a desirable viscosity range for backcoat compositions was 1,000 to 15,000 centipoises (col 1, line 70). The '936 patent describes hot melt adhesive compositions very similar to those in the Smedberg '600 reference. In the '936 patent (col.1, line 69), a Brookfield spindle No. 7 and a spindle speed of 50 rpm were used to measure viscosity. For that reason, we have assumed Smedberg's viscosity range in the '600 reference was obtained in the same manner.

How Shear Rate of Smedberg '600 reference is determined based on Spindle used to calculate Viscosity:

37. A Brookfield RVT viscometer has a very different configuration than a capillary rheometer. The Brookfield unit uses a rotating spindle to measure viscosity. To obtain a reading, the resin is heated to a designated temperature, and a spindle of a specific size is inserted. As the spindle rotates at a preset speed, the opposing force (drag) is measured. The size of the opposing force is related to the viscosity of the fluid. A larger drag force corresponds to a higher viscosity. The shear rate under which the measurement is taken is calculated by multiplying the speed of rotation (in rpm) by a

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factor unique to that spindle design. In contrast to the MI results obtained using ASTM D 1238, Brookfield rotary viscometer readings are generated under conditions of constant shear rate.

38. Since the spindle mentioned in the Stahl '936 patent was No. 7 (which has a factor of 0.209) and the speed of rotation was 50 rpm, the shear rate for the measurement was (50 rpm) X (0.209) = 10.45 sec^{-1}. This value is essentially the same as the shear rate of 9.97 sec^{-1} in the capillary rheometer for the MI 2.2 polyethylene resin of this invention. See Figure 1 below that illustrates typical spindles for Brookfield viscometers and the data for Spindle No. 7 taken from the technical publication, "More Problems to Sticky Solutions", page 32, which is available at the Brookfield Engineering Labs website.

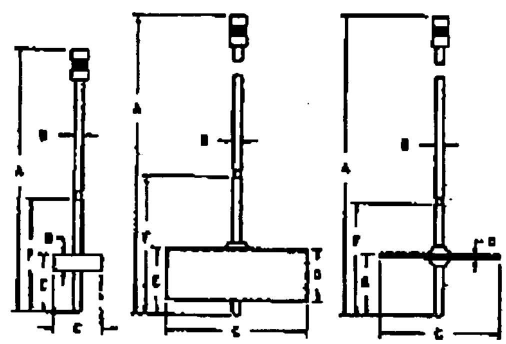

Fig. 1 Fig. 2 Fig. 3

A.4 Cylindrical Spindles for Dial-Reading Viscometer and Digital Viscometers/Rheometers

Cylindrical Spindle Factors and Shear Rates

Spindle	LV	RV**	HA**	HB**	Shear Rate (sec^{-1})
#1 LV	72/N*	780/N	1560/N	6240/N	0.220N
#2LV CYL	330/N	3350/N	6700/N	26.8M/N	0.212N
#3 LV CYL	1200/N	12.9M/N	25.8M/N	103.2M/N	0.210N
#4 LV	6000/N	64M/N	128M/N	512M/N	0.209N
#5 LV CYL +	12M/N	128M/N	256M/N	1024M/N	0.206N
#7 RV/H	3750/N	40M/N	80M/N	320M/N	0.209N

*N = RPM M = 1000 + = Optional Item

**Factors are for readings made without using the guardleg.

MORE SOLUTIONS TO STICKY PROBLEMS Page 32 Brookfield Engineering Labs., Inc.

Figure 1 - Brookfield Spindles

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Viscosity and Shear Rates of Smedberg '600 reference compared to Embodiments of the Claimed Invention:

39. Since we now have an estimate for the shear rate for the Smedberg '600 viscosity measurement and have data at similar shear rates for the polyethylene resins of the instant invention, we can compare the viscosity of the hot melt backsize compositions of Smedberg with the viscosity of polyethylene resins of the instant invention. Table II shows that comparison at a test temperature of 270°F, a temperature common to both the Smedberg patent and the instant invention.

Table II. Viscosity Comparison at 270°F

Resin	Melt Index (g/10 min)	Shear rate (sec^{-1})	Viscosity (Pa-sec)	Viscosity (centipoises)
Polyethylene in Examples 2, 17, 18, and 37	105	10^B	230	230,000
Polyethylene in Examples 1 - 40	27	10^B	650	650,000
Polyethylene in Example 41	2.2^A	9.97	4,881	4,881,000
Smedberg '600 hot melt range	N/A	10.45	5-50	5,000 – 50,000

A = substituted for MI 3 resin that is no longer available
B = extrapolated from flow curve. Closest data point at 97 sec^{-1}.

The data in Table II shows clearly that the viscosities of the thermoplastic resins of this invention are substantially higher than the viscosity range in the Smedberg '600 reference.

Differences and Unexpected Results for Claimed Invention:

40. Because the viscosities of embodiments of the claimed invention are substantially higher than the viscosities of the Smedberg '600 reference, I believe that the claimed invention of this application is distinct from and unexpected based on the teachings of Smedberg '600 reference. The fact that a combination of improved fuzz resistance <u>and</u> significantly improved tuft bind can be very often be achieved with the very small amount of stitch binder and the <u>viscous</u> thermoplastic resins of the claimed

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invention is very surprising and unexpected. These unexpected results are reinforced by the data contained in Tables 2, 3, 5, 6, 7, and 8 of the originally filed application.

41. Therefore, as one of ordinary skill in the art and in view of these unexpected results based on the parameters recited in each of the amended independent claims, I believe that the claimed combination of elements that include a thermoplastic binder that consists entirely or essentially of a thermoplastic polyethylene resin having flow properties corresponding to an MI of about 2.2 to about 105 g/10 min as measured in accordance with ASTM D 1238; and a viscosity between approximately 230,000 and 4,881,000 cps at about 270°F with a shear rate of about 10 sec^{-1} as measured in accordance with ASTM D 3835, as recited by each of the amended independent claims of this application are patentable over the Smedberg '600 reference and the remaining prior art of record. Accordingly, reconsideration and withdrawal of the rejection based on the Smedberg '600 reference are respectfully requested.

42. I further declare that my statements made herein of my own knowledge are true, and that all statements made on the information and belief are believed to be true; and further that these statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements and the like so made may jeopardize the validity of this declaration, the subject application or any patent issuing thereon.

Respectfully submitted,

Hugh C Gardner

Hugh C. Gardner

19 July 2005

Date